Interstate Differences in Residential Electricity Use

By Dennis Heffley

That time of year again! Oil-hooked New Englanders begin their winter ritual: breaking out the tacky draft-stopper for the front door, lowering the storm windows, and making sure the boiler is burning clean. In other parts of the country, where oil is just something you put in your car, the ritual consists of a change in the electric bill. The different rituals reflect very different, though (it turns out) predictable, patterns of energy use.

By U.S. standards, electricity use in Connecticut and other New England states is modest. In 2000, Connecticut's residential use—3,415 KWHPC (kilowatt hours per capita)—ranked 35th, about half that of top-ranked Alabama (6,460). Other New England states ranked even lower—Rhode Island's 2,537 KWHPC was 47th, not much above bottom-ranked New York at 2,265.

So why do Connecticut residents and their neighbors use so little electricity? The quick answer is that they rely more heavily on other energy sources, especially fuel oil and natural gas. But why? Compared to the alternatives, electricity seems to be cleaner, safer, and lower-maintenance—at least at the household level. Other things equal, electricity ought to be the preferred source of domestic energy.

Other things aren't equal, of course. The prices of electricity and its substitutes, such as oil and gas, vary by state, as do income, climate, and other factors shaping demand for electricity.

Watts Up?

To explain the variation in state electricity use, I estimated a multivariate regression model using state-level data for 2000. Following the basics of consumer demand, I expected the measure of residential electricity use (KWHPC) to be negatively related to the price per KWH and positively related to per capita disposable income and the prices of #2 heating oil and natural gas—both substitutes for electricity.

Housing prices might indirectly affect electricity use. In economic parlance, electricity and housing are "complementary goods"—used together. If higher housing prices reduce the size of housing units, less electricity should be used, implying a negative expected relationship between electricity use and housing prices (median gross rent per room, constructed from 2000 Census data).

Sources of Interstate Differences in Residential Electricity Use

	Expected Sign	Estimated Elasticity
*Price of Electricity	-	-0.61
Price of Heating Oil	+	
Price of Natural Gas	+	
*Per Capita Disposable Income	+	0.72
Price of Housing	-	
*Percent Metro	-	-0.37
*Heating Degree Days (Cold Weather)	-	-0.25
*Cooling Degree Days (Hot Weather)	+	0.10

* Indicates statistical significance at the 10% level or better

The spatial configuration of housing also affects electricity use. Housing clustered in metropolitan areas, often in multifamily units, is probably more energy-efficient than low-density suburban or rural housing. So, a higher percentage of the state's population living in metro areas was expected to reduce per capita electricity use.

Finally, I included two measures of climate: heating degree days for cold weather and cooling degree days for hot weather. With present technologies, electricity is better suited to cooling, while oil is better suited to heating. Thus, I expected electricity use to be negatively related to heating degree days and positively related to cooling degree days.

Findings

The regression results generally matched my expectations. For each explanatory variable, the table below gives the expected sign of the regression coefficient and the estimated elasticity—the percentage change per capita use due to a one percent increase in that variable. Of the eight variables, five were statistically significant: the price of electricity, per capita disposable income, percent metropolitan, heating degree days, and cooling degree days. After controlling for such differences, the prices of heating oil, natural gas, and housing appear to have little effect on electricity use. Jointly, the explanatory variables account for three-fourths of the interstate variation in residential use, and the model does a particularly good job of predicting (3,405) Connecticut's actual use (3,415) based on its characteristics.

The elasticity estimates show how electricity use responds to differences in the statistically significant variables as we look across states. For example, a state with 10% higher electricity prices uses about 6.1% less electricity per person than an otherwise comparable state. Similarly, a state with 10% more heating degree days uses about 2.5% fewer KWHPC, as consumers rely more heavily on fossil fuels to heat their homes.

The model also explains why neighboring states like Connecticut and Rhode Island use such different amounts of electricity. Connecticut's residential use (3,415) exceeds Rhode Island's (2,537) by nearly 35%. Much of the difference is driven by Connecticut's 33% higher income. Holding Rhode Island's other features constant but increasing its per capita disposable income ($24,983) to the Connecticut level ($33,142), the model predicts that an artificially "richer" Rhode Island would use 3,323 KWHPC, not much below Connecticut's figure.

Higher Rates Ahead?

The 8/14 Northeast blackout has prompted calls to upgrade the electric power network. Such investments will likely require higher rates for users, but some of them will argue that rates are already too high. The most recent federal data, for July 2003, show Connecticut residents paying 11.58 cents per KWH, 10th highest in the nation, 27 percent above the 50-state average of 9.11 cents, and almost twice the low Kentucky price of 5.92 cents. We'd need a more complete study to determine if Connecticut's relatively high prices reflect higher costs of supplying electricity, demand-side differences, industry structure, or the state's regulatory apparatus. What's clear, though, is that the price of residential electricity in Connecticut has been pretty stable since 1990, and has actually declined relative to the CPI. The bar graph on page 3 shows both the nominal price per KWH, computed from annual data, and the real price per KWH. Since 1990, the real price has declined more than 20 percent. Unless Connecticut's electric utilities are simply riddled with waste, it's difficult to see how such investments can be made without rate increases. Time to also invest in a new draft-stopper?